PTO 09-2993

CC=Japan
DATE=19830604
KIND=Kokai
PN=58094149

METHOD FOR MANUFACTURING A MASTER PLATE FOR PREPARING OPTICAL INTERFERENCE-TYPE GUIDE CHANNELS FOR AN OPTICAL DISC

[Hikari Disuku no Kōkansho Gata Annai Kō Seisaku Yō Genpan no Seizō Hō]

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UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. February 2009
TRANSLATED BY: SCHREIBER TRANSLATION, INC.

PUBLICATION COUNTRY	(10):	Japan
DOCUMENT NUMBER	(11):	58094149
DOCUMENT KIND	(12):	Kokai
PUBLICATION DATE	(43):	19830604
APPLICATION NUMBER	(21):	56192113
APPLICATION DATE	(22):	19811130
INTERNATIONAL CLASSIFICATION	(51):	G 11 B 7/26 G 03 C 5/00
PRIORITY COUNTRY	(33):	N/A
PRIORITY NUMBER	(31):	N/A
PRIORITY DATE	(32):	N/A
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DESIGNATED CONTRACTING STATES	(81):	N/A
TITLE	(54):	METHOD FOR MANUFACTURING A MASTER PLATE FOR PREPARING OPTICAL INTERFERENCE-TYPE GUIDE CHANNELS FOR AN OPTICAL DISC
FOREIGN TITLE	[54A]:	Hikari Disuku no Kōkansho Gata Annai Kō Seisaku Yō Genpan no Seizō Hō

Specification

1. Title of the invention

Method for manufacturing a master plate for preparing optical interference-type guide channels for an optical disc

2. Patent Claim

1. A method for manufacturing a master plate for preparing optical interference-type guide channels for an optical disc characterized by the recording, by irradiating a pair of laser beam luminous fluxes on a photoresist layer formed above a substrate, of interference fringes and then of the development of the same.

3. Detailed explanation of the invention

The present invention concerns a method for manufacturing a master plate for preparing optical interference-type guide channels for an optical disc, and more specifically, it concerns a method for manufacturing a master plate for preparing an optical disc constituted to possess, by taking advantage of interference fringes obtained as a result of the interference of beams with a high coherence (e.g., laser beams, etc.), guide channels easily detectable and excellent in terms of precision, to facilitate random accesses, and to favor mass production.

The optical recording format is an excellent recording format in the sense that it is capable of upping, by at least one order of significance, the recording density in

comparison with the magnetic recording format, although it requires, for purposes of recording specified information at a certain position and of detecting the same, a label expressing the recording position.

In the absence of a label, the precision of the position of encoded information becomes inevitably determined by the mechanical positioning precision, and therefore, it becomes impossible to designate an arbitrary recording position, to commence playback from said position, and to maintain (e.g., add, delete, alter, etc.) encoded information, which in turn precludes so-called "random accesses."

On an occasion for recording and playing back various sets of information onto and from a singular optical disc, furthermore, information groups can be individually distinguished more easily in a case where recording zones are configured concentrically than in a case where the same are configured spirally, as on record discs (i.e., sound recording discs for music, etc.). Optical interference-type guide channels serving as labels on recording/playback occasions have, however, been traditionally configured on a master plate in a concentric fashion by exposing, onto a photosensitive material wherein a photoresist, etc. have been formed on the surface thereof, one line each, namely one circle each, and by then developing the same, due to which the efficiency is inferior, and furthermore, the interval in-between mutually adjacent circles becomes inevitably determined exclusively by mechanical precision.

The present invention, which has been conceived for the /3 purpose of eradicating the aforementioned shortcomings of the prior art, is to disclose a method for manufacturing a master plate capable, by taking advantage of the interference of laser beams, of preparing optical interference-type guide channels in a favorable preparation efficiency and in an excellent precision. In other words, the present invention concerns a method for manufacturing a master plate for preparing optical interference-type guide channels for an optical disc characterized by the recording, by irradiating a pair of laser beam luminous fluxes on a photoresist layer formed above a substrate, of interference fringes and then of the development of the same.

In the following, the present invention will be explained in detail.

As far as types of optical discs to which the present invention can be applied are concerned, there are no restrictions on the constituent materials and recording/playback principles thereof, although ones provided by configuring, above substrates comprising of sheets or panels of thermoplastic synthetic resin sheets, optical recording layers comprising of low-melting-point metal thin films of Te, Bi, In, Pd, etc. and/or laminates thereof are desirable in consideration of mass production prospects.

Next, the optical interference-type guide channel for expressing, on optical recording and playback occasions, a

recording position configured on the surface of an optical disc will be discussed; as the abstract representation of Figure 1 indicates, such a channel is configured, in a concentric fashion as expressed by the notation (1), on the surface of an optical disc (2) in possession of a hole. Figure 2 is a diagram which shows a partial lengthwise cross-sectional view of the shape of the optical interference-type guide channel of the optical disc of Figure 1, according to which the peak unit (3) of each protrusion of the optical interference-type guide channel (1) and the bottom unit (4) of the depression of the same are flatly formed, whereas the planes thereof are parallel to the substrate. In Figure 2, it is desirable, in consideration of practical utility, for the width of the protrusion unit (3) along the left-right direction on the drawing to be 0.5 ~ 2 μm and for the width of the depression unit to be likewise 0.5 ~ 2 μm, although such an embodiment is not binding. Moreover, it is conceivable for the span from the bottom of the depression to the peak of the protrusion, namely the depth of the optical interference-type guide channel, to be designated within a range of 0.1 ~ 10 μm, although since the depth of the optical interference-type guide channel bears a close relationship with the wavelength of a laser beam used for recording and playback, it is desirable, in a case where the wavelength of the laser beam is defined as λ, for the same to coincide with $\lambda/4$, $\lambda/8$, ...

In a case where a laser beam has become irradiated, as a spot of a certain size, onto the optical disc in possession of the foregoing optical interference-type guide channel, an optical path differential equivalent, as has been mentioned earlier, to $\lambda/4$, $\lambda/8$, ... arises between the beam reflected by the peak of the protrusion of said guide channel and the beam reflected by the bottom of the depression of the same, as a result of which it becomes possible, due to the arising of an optical interference, to detect the recording position with ease.

Next, methods for manufacturing an optical disc in possession of the foregoing optical interference-type guide channel will be discussed.

Figure 3 and Figure 4 are abstract diagrams demonstrating one application embodiment of the present invention.

First, a photoresist solution is coated, by means of spinner coating, etc., on an appropriate flat substrate (10a) such as a glass, etc., as a result of which a photoresist (10b) becomes formed, and a photoresist master plate (10) becomes formed. The photoresist (10b) may be either of the positive or negative type. Next, as Figure 3 indicates, a laser beam emitted from a laser beam source (5) is split into a pair of luminous fluxes by a half mirror (6), whereas in a case where these two luminous fluxes become reflected respectively by mirrors (7a) and (7b) and then each converted into scattered beams by using lens systems (8a) and (8b) (a

pair of convex lenses are shown as a set) and where both luminous fluxes become irradiated onto the aforementioned photoresist at an intersecting angle of θ, a concentric optical interference fringe pattern bearing a pitch of d, which is determined by the relation formula of

$$d = \lambda / \mathrm{Sin}\theta,$$

becomes generated. On the foregoing irradiating occasion, the photoresist master plate (10) is fixed, via a vacuum chuck, etc., to a rotary platform (11), whereas a mask (12) in possession of a slit-shaped window along the radial direction of the photoresist master plate is fixed in high proximity to said master plate, whereas in a case where an irradiating operation is carried out by rotating the rotary platform (11), a concentric interference fringe pattern becomes recorded onto the photoresist layer, whereas in a case where the same is then developed based on a specified method, depressions and protrusions proportional to beam intensities on the interference fringe pattern become formed.

According to the foregoing manufacturing method, the depth of the optical interference-type guide channel becomes determined by the thickness of the resist layer, although it is also possible to lessen said depth by controlling the development. Moreover, it is desirable for the slit width of the aforementioned mask to be narrow, for the precision of the interference fringe pattern recorded on the photoresist becomes adversely affected as the same becomes broad, and therefore, a range of 0.1 mm ~ 10 mm or so is desirable.

Although the photoresist master plate is rotated according to the embodiment explained above, a method wherein a recording action is invoked in a state where a photoresist master plate is being fixed is also permissible, as shown below.

Figure 5 is an abstract diagram which shows another application embodiment of the present invention, according to which a laser beam emitted from a laser beam source (5) is divided into a pair of luminous fluxes by a half mirror (6),

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whereas one of said luminous fluxes is converted into a parallel beam by the lens system (8) via mirrors (7a) and (7b) and then guided to a photoresist master plate (10) comprising of a photoresist (10b) and a substrate (10a), whereas the other luminous flux becomes converted into a scattered beam by a convex mirror (9) and then guided to the photoresist master plate (10), whereas interference fringes arise as a result of the interference of both beams. According to this application embodiment, however, the intersecting angle θ is the intersecting angle of the two beams at an arbitrary point above the photoresist master plate, and therefore, the θ value becomes lower toward the center of the photoresist master plate, whereas the interface fringe interval accordingly tends to become enlarged toward the center of the photoresist master plate.

The efficiency of either of the aforementioned embodiments of the present invention is higher than that of

the method of the prior art wherein one line each, namely one circle each, is exposed, whereas, as has been mentioned above, the concentric circle precision is determined by

$$d = \lambda/\mathrm{Sin}\theta,$$

whereas λ is fixed under the pervasion of an invariable laser beam source, whereas since θ is devoid of variance once the exposure device becomes fixed, a favorable exposure precision can be secured without being affected by mechanical precision, and a master plate for preparing optical interference-type guide channels for an optical disc can be quickly obtained in a favorable precision.

4. Brief explanation of the figures

Figure 1 and Figure 2 are respectively an abstract diagram and a partial lengthwise cross-sectional view diagram pertaining to an optical disc in possession of optical interference-type guide channels, whereas Figure 3 through Figure 5 are abstract diagrams demonstrating application embodiments of the present invention.

(1): Optical interference-type guide channel;

(2): Optical disc;

(3): Peak unit of protrusion;

(4): Bottom unit of depression;

(5): Laser beam source;

(6): Half mirror;

(7): (7a), and (7b): Mirrors;

(8a) and (8b): Lens systems;

(9): Convex mirror;

(10): Photoresist master plate {(10a): Substrate; (10b): Photoresist};

(11): Rotary platform;

(12): Mask.

Figure 1

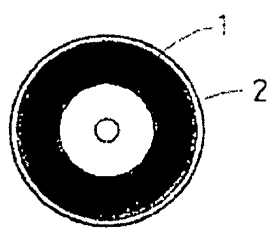

Figure 2

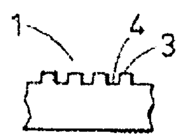

Figure 3

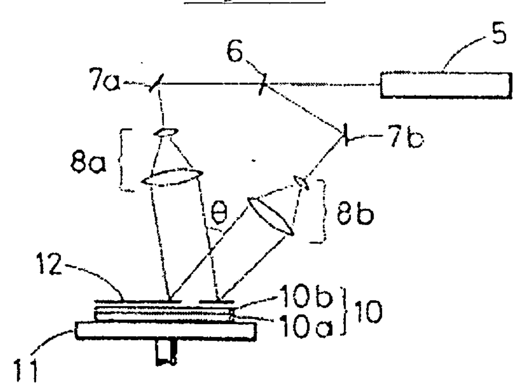

Figure 4

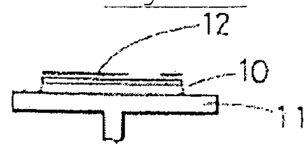

Figure 5